

### REMARKS

This is in response to the Office Action of September 12, 2005. The feature of claim 4 is incorporated into claim 1, and claim 4 is accordingly cancelled without prejudice. Claim 1 is also amended to recite pad size in accordance with such disclosure as that in Example 2 herein. Claim 5 is cancelled, without prejudice, in order to reduce the number of claims under consideration by the Examiner. No new matter is introduced by this Amendment. Claims 1-3 and 6 are pending in the application.

THE INVENTION. The present invention relates to the manufacture of small-sized, light weight electronic parts. The development of small-sized electronic parts has made the surface area available for connecting terminals, such as terminal electrodes, quite small. Therefore, weakly bonded connections tend to be formed. A need has arisen to increase connection reliability. Solder containing lead (e.g., Sn-Pb solder) conventionally has been in general use for such connections. However, lead-containing tin solder is undesirable. This is because machinery, tools, and parts containing tin-lead solder cause environment pollution. After being discarded, they are deteriorated by rain, snow, and weathering, giving rise to soil-pollution and drinking-water pollution attributed to their lead components, with consequent serious damage to the environment. However, *lead-free* solders for the connection of electroless Ni platings having outer diameters of 300  $\mu\text{m}$  or less (that is, small-sized applications) have several problems: their bonding strength decreases more than in the case of Sn-Pb solders; electroless Ni plating is eluted into a solder after repeating reflow; and surface oxidation occurs when plating a gold thin film, with concomitant impairment of reliability of the connected part.

Applicant has discovered that bonding properties between the solder and the electroless Ni plating can be improved by "keeping the half-width of X-ray diffraction of a (111) plane of Ni crystal in the nickel plating coat within a range of 4 degrees to 2 degrees," in the case of forming the electroless nickel plating coat containing phosphorous on a

substrate metal layer which constitutes a connecting terminal of an electronic part, even with pad sizes as small as 300  $\mu\text{m}$  or less. This benefit of the present invention is clearly demonstrated in the examples in the specification of the present application.

Claims 1-6 were rejected under 35 USC § 103(a) as being unpatentable over US 6,146,702 (Zitko) in view of US 6,403,400 B2 (Lin).

Zitko merely discloses conditions for electroless plating to enhance the “wear resistance” of the plating to other metals. The “wear resistance” of concern to Zitko has nothing to do with improvement of the connection (bonding power) between a lead-free solder and electroless plating. The Zitko reference is concerned with wear resistance of tools, household appliances, machine parts, pumps, and gears, etc., which technology is quite different from – and totally irrelevant to – pads 300  $\mu\text{m}$  or less on wafer surfaces. There is no rationale of record to support the application of the large scale technology disclosed in Zitko to the improvement of bonding power between lead-free solder and electroless Ni coating in the very small scale technology of the present invention.

The Examiner argues with respect to Zitko that it is inherent that a half-width of X-ray diffraction of a plane of Ni crystal in the nickel plating coat will be 5 degrees or less, since Zitko discloses forming an electroless nickel plating containing phosphorous on a metal substrate with the same weight composition and annealing temperature as Applicant. However, Zitko’s coated alloy – composed of nickel, cobalt, and phosphorus – is strikingly different from the coating composition composed of nickel and phosphorus of the present invention. The difference in chemical compositions between Zitko and the present invention prevents the inference that Zitko’s substance has a half-width of X-ray diffraction of a (111) plane of Ni crystal of 4 to 2 degrees like Applicant’s substance. There is simply no scientific justification for the belief that mere coincidence of phosphorus content can lead to a crystal of the same half-width of X-ray diffraction being formed. Due to the differences between the compositions involved, it cannot be assumed that the same crystal is formed. The Examiner’s statement of the rejection, which depends on inherency, is therefore

manifestly improper. The alleged inherency is based on an incorrect presupposition, and neglects the significant differences in the compositions of the alloys.

The Lin reference generally teaches that a lead-free solder can be applied to a nickel-plated layer. However, no details are disclosed concerning the precise composition of the lead-free soldering. Lin also does not provide any suggestion that his composition has a half-width of X-ray diffraction of a (111) plane of Ni crystal in the nickel plating coat that is within a range of 4 degrees to 2 degrees.

Neither Zitko nor Lin, alone or in combination, teaches or suggests the employment of a Ni crystal plated coat that has a half-width of X-ray diffraction of a (111) plane in a range of 4 to 2 degrees. The invention presently claimed as a whole is therefore not obvious from the references applied. Withdrawal of the rejection of record is respectfully solicited.


In response to the Examiner's request concerning reference numerals on page 3 of the Office Action, Applicant respectfully requests reconsideration thereof. The presently claimed invention is a method rather than, for instance, an apparatus. The present claims recite compositional parameters that are not depicted in Applicant's drawings with reference numerals (e.g., 300  $\mu\text{m}$ , X-ray diffraction of a (111) plane, a range of 4 degrees to 2 degrees). Accordingly, the present invention does not lend itself to explications that depend upon the citation of drawing reference numerals.

If there are any questions concerning this application, the Examiner is requested to contact Richard Gallagher, Registration No. 28,781, at (703) 205-8008.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

By 

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